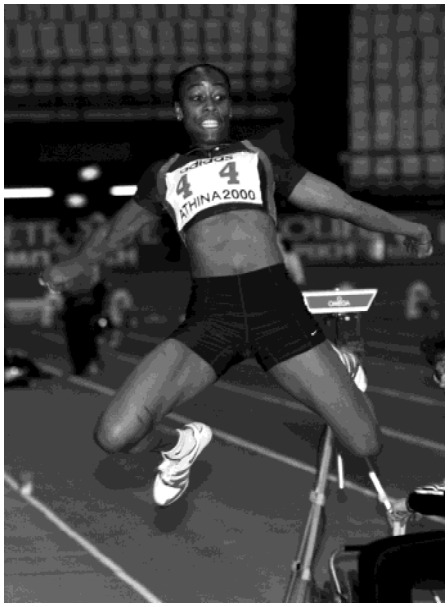
CURBSIDE CONSULT

Can exercise-induced muscle damage be avoided?

All athletes have experienced the discomfort and debilitating effects of exercise-induced muscle damage. Symptoms are most common at the beginning of the season when intense training is reintroduced after a period of relative inactivity. A plethora of scientific data describes exercise conditions that lead to muscle damage. It is well accepted that damage occurs with unfamiliar exercise, primarily involving eccentric contractions. For example, downhill running places a large eccentric stress on the quadriceps muscle group and commonly results in muscle damage.[1] However, muscles that have been preconditioned with eccentric contractions are protected against damage from subsequent bouts of eccentric exercise. This muscle damage is known as the "repeated-bout effect" and has been shown with various forms of exercise in both humans and animal models.[2] Despite the many studies describing muscle damage and its various clinical symptoms, few have identified intrinsic causative factors or suitable interventions for limiting the symptoms. Clinically, it is important to first identify people at risk of developing more severe symptoms and then to design interventions that might limit those symptoms. Three recent experimental studies provide clinically relevant information for athletes and physicians.[3-5]

Controlled experimental studies have shown wide variation in symptoms between subjects after a bout of unfamiliar eccentric exercise. These data indicate that some people are more susceptible to damage than others, but it is not clear why. Recently musculoskeletal flexibility has been shown to be an important factor affecting the severity of symptoms after eccentric exercise.[3] Flexibility was quantified according to a measure of passive muscle stiffness, and subjects' muscles were categorized as "stiff," "normal," or "compliant." After a bout of eccentric exercise, subjects with stiff muscles had significantly greater loss of strength, pain, muscle tenderness, and elevation of plasma creatine kinase activity than those with compliant muscles. Greater apparent muscle damage was attributed to the inability of the tendon and aponeurosis of stiffer muscles to absorb the lengthening imposed by the eccentric contractions.



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Long jumper Adrien Sawyers: even elite athletes risk muscle damage

Warm-up and stretching are known to greatly reduce muscle stiffness.[6] Because stiffness seems to predispose muscles to damage, it follows that appropriately warming up before exercise may reduce the severity of exercise-induced muscle damage. It has also been shown that warm-up reduces subsequent symptoms of muscle damage.[4] Eccentric contractions of the elbow flexors preceded by a warm-up resulted in significantly less loss of strength and elevation of plasma creatine kinase activity than eccentric contractions without a prior warm-up. The protective effect was attributed to decreased passive muscle stiffness, although actual stiffness measurements were not made.

Besides the possible role of warm-ups in limiting the symptoms of muscle damage, preconditioning the muscle with eccentric contractions clearly provides a protective effect (repeated-bout effect). Recent data suggest that it may not be necessary to damage the muscle with the initial bout to provide a protective effect.[5] Brown and associates showed that as few as 10 maximal eccentric contractions of the knee extensors were sufficient to reduce symptoms appreciably after a subsequent bout of 50 maximal contractions performed three weeks later. There was a clear repeated-bout effect despite that 10 contractions did not result in appreciable muscle damage. These data indicate that preconditioning muscles with a few maximal eccentric contractions can considerably reduce symptoms after a subsequent, more intense, bout of eccentric exercise. The key elements for the repeated-bout effect are that the preconditioning contractions are eccentric, that high-intensity contractions are performed, and that the preconditioning contractions affect the same muscle groups that will be working eccentrically in the repeated bout.

All dynamic sports activities involve a large component of high-intensity eccentric contractions, whether the activity is in a game or a practice. Athletes typically experience considerable symptoms of muscle damage when returning to these activities after a prolonged layoff because of injury or between seasons. The severity of these symptoms may be reduced by maintaining good flexibility, especially of the principal muscle groups involved in the given sport; preconditioning the principal muscle groups with a few high-intensity eccentric contractions one to two weeks before returning to full activities; and performing specific warm-up exercises for the

principal muscle groups immediately before the first few training sessions or games. Increasing the athletes' awareness of the cause of symptoms will increase compliance with any intervention directed at limiting muscle damage. This is especially important in sports that do not place a large emphasis on warm-up or flexibility.

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